

R E M A R K S

The Examiner's rejection of claims 1 and 3-9 as being unpatentable over the Japanese Patent Publication No. 63-261833 combined with the Wolf publication and the Bayraktaroglu Patent No. 5,166,033 is respectively traversed. The rejection is believed to be incorrect for the reasons set forth hereinafter.

Claim 1, the only independent claim, is directed to a process for fabricating a semiconductor device having a buried layer and it requires, inter alia, forming a buried implanted impurity ion region at a location which is spaced below a surface of a substrate where a buried layer is to be formed in the substrate, placing the substrate inside a reactor furnace and, while maintaining the substrate in the reactor furnace, providing a nonoxidizing atmosphere inside of the reactor furnace, annealing the substrate to activate implanted impurity ions by increasing the internal temperature of the reactor furnace up to a first temperature wherein the first temperature does not cause oxide induced stacking fault to occur in the nonoxidizing atmosphere, and before the buried ion implanted region beneath the surface of the substrate expands upwardly sufficiently to reach the surface of the substrate, changing the internal temperature of the reactor furnace from the first temperature to a second temperature of approximately 1,000 Centigrade, during which time the buried implanted impurity ion region diffuses both upwardly and downwardly from the location below the surface of the substrate, so as to allow an epitaxial crystal to start growing on the surface and introducing an epitaxial growth gas into the reactor furnace to cause an epitaxial layer to grow on the surface of the substrate, thereby

inhibiting autodoping and formation of crystal defects in the epitaxial layer, and then removing the substrate from the reactor furnace.

With this method, an implanted ion region beneath the surface of the substrate is produced in such a way that there is little chance that crystal defects are produced in the substrate surface and no autodoping of the epitaxial layer is caused. Moreover, the problems resulting from carrying out the annealing step and the epitaxial growth step and different furnaces are effectively eliminated.

This unique method is not disclosed in or in any way suggested by the prior art relied upon in support of the rejection. In the Japanese reference, there is nothing that states or in any way implies that the steps are carried out “all in the same reactor furnace in a non-oxidizing atmosphere”, nor is there anything that states or in any way implies that the annealing step is carried out at the first temperature. As acknowledged by the Examiner, that reference is completely silent on the nature of the atmosphere in the furnace during the course of the annealing process, and contrary to the Examiner’s contention, it is improper to read into that reference the presence of a non-oxidizing atmosphere during that step. On the contrary, there is no implication whatsoever that the atmosphere should be non-oxidizing in the Japanese process. Additionally, the Japanese reference does not disclose annealing the substrate to activate implanted impurity ions by increasing the internal temperature of the reactor furnace up to a first temperature wherein the first temperature does not cause oxide induced stacking fault to occur.

The Examiner incorrectly asserts that a non-oxidizing atmosphere is inherent based on the fact that there is no disclosure in either of the Japanese reference or the Wolf

reference regarding oxide formation and removal. It is clearly improper to read into the disclosures of those references a requirement for a non-oxidizing atmosphere when the same result can be accomplished by removing an oxide layer formed as a result of annealing in an oxidizing atmosphere. Thus, the absence of disclosure cannot be used to imply the presence of a condition required by the claimed process.

Furthermore, the Examiner incorrectly asserts that the “annealing/activation and epitaxial growth steps would have been a matter of routine optimization because temperatures for the steps are recognized as result effective variables.” Official Action, p. 4. The Applicants assert that establishing the first temperature such that the first temperature does not cause oxide induced stacking fault to occur is not recognized as a result effective variable, nor is it suggested, much less disclosed by the Japanese reference, alone or in combination with the Bayraktaroglu reference and the Wolf reference. Only the Wolf reference mentions oxide induced stacking fault. Wolf reference, p. 305. However the Wolf reference only mentions oxide induced stacking fault in connection with the atmosphere to be used during an annealing process. No mention is made in the Japanese reference, the Bayraktaroglu reference or the Wolf reference concerning establishing a temperature whereby oxide induced stacking fault does not occur.

Moreover, the Bayraktaroglu reference does not overcome the deficiencies of the Japanese reference and Wolf. Contrary to the contentions in the Examiner’s action, Bayraktaroglu does not disclose or suggest an annealing process carried out in the same reactor as an epitaxial growth process but merely teaches activation of implanted ions and

epitaxial growth in the same reactor. Activation of implanted ions does not require or imply annealing and a person skilled in the art reading the Bayraktaroglu reference would not be led to reconstruct the processes of the Japanese reference and the Wolf reference to carry out annealing in the same reactor as epitaxial growth as required by claim 1.


Furthermore, there is no suggestion in any of the references that the disclosure of the Japanese reference or the Wolf reference should be modified by the disclosure of the Bayraktaroglu reference. As noted in the cases cited in the previous response filed December 26, 2001, it is essential that there be a teaching, motivation or suggestion in the prior art to combine or modify reference disclosures and it is insufficient to rely on an assertion that it would "be within the scope of one of ordinary skill in the art" as stated in the Examiner's Action. There is no such suggestion in any of the references and the Examiner has not even cited any part of a reference in support of an assertion that the modifications require to meet the claim requirements are suggested by the prior art.

Accordingly, claim 1 is clearly patentable over the prior art, including the newly cited reference, and should be allowed along with its dependent claims 3-6.

Further and favorable action is respectfully requested.

Respectfully submitted,

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

1. A process for fabricating a semiconductor device having a buried layer comprising the steps of:

forming a buried implanted impurity ion region at a location which is spaced below a surface of a substrate where a buried layer is to be formed in the substrate;

placing the substrate inside a reactor furnace and, while maintaining the substrate in the reactor furnace;

providing a nonoxidizing atmosphere inside of the reactor furnace;

annealing the substrate to activate implanted impurity ions [and diffuse the buried implanted impurity ion region both upwardly and downwardly from the location below the surface of the substrate while] by increasing the internal temperature of the reactor furnace up to a first temperature wherein the first temperature does not cause oxide induced stacking fault to occur in the nonoxidizing atmosphere; and

before the buried ion implanted region beneath the surface of the substrate expands upwardly sufficiently to reach the surface of the substrate, changing the internal temperature of the reactor furnace from the first temperature to a second temperature of approximately 1,000 Centigrade, during which time the buried implanted impurity ion region diffuses both upwardly and downwardly from the location below the

surface of the substrate, so as to allow [at which] an epitaxial crystal [starts] to start
growing on the surface and introducing an epitaxial growth gas into the reactor furnace to
cause an epitaxial layer to grow on the surface of the substrate, thereby inhibiting
autodoping and formation of crystal defects in the epitaxial layer; and
then removing the substrate from the reactor furnace.